

DEVELOPMENT OF THE BLACK WILLOW SCALE, *CHIONASPIS SALICISNIGRAE* (HOMOPTERA: DIASPIDIDAE), IN TENNESSEE¹

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ABSTRACT: Weekly collections of the black willow scale, *Chionaspis salicisnigrae*, on *Salix nigra* were made from 7 January 1984 to 31 December 1989 to determine the life history of the species. This species overwintered as eggs and had three generations per year in Tennessee. Each female deposited a mean of 152 (18-265) eggs beneath a waxy, tentlike covering. Adult males emerged in May, August and September. Behavioral aspects of each instar are discussed.

The black willow scale, *Chionaspis salicisnigrae* (Walsh), was originally described in 1868 from specimens collected on black willow, *Salix nigra* Marsh. Species of *Chionaspis* are predominately mono- or oligophagous insects (Takagi 1969). The black willow scale has been collected from the bark and leaves of several ornamental trees in the United States that include: *Amelanchier canadensis* (L.), (Rosaceae); *Cornus pubescens* Nutt. and *C. asperifolia* Michx., (Cornaceae); *Fraxinus americana* L. (Oleaceae); *Populus canadensis* Moench., *P. candicans* Ait., *P. deltoides* Marsh., *P. grandidentata* Michx., *P. tremuloides* Michx., *Salix interior* Rowlee, *S. nigra* Marsh., and *Salix* sp. (Salicaceae), (Kosztarab 1963, Dekle 1976). Willow trees, planted to enhance the aesthetic beauty of residential areas, are often infested with this pest. Damage to the host is caused by sap extraction which results in loss of vigor, dieback, stunting and eventual death of the affected plant.

The black willow scale was reported to infest native willows in Indiana and occasionally became an economic problem (Diez and Morrison 1916). Langford (1926) concluded that this species had two generations in Colorado with eggs hatching in late April and July, respectively. Also, Houser (1918) and Kosztarab (1963) reported that the overwintering eggs hatched in mid-May in Ohio and that *C. salicisnigrae* may have two generations per year. Because little information is known concerning the biology of the black willow scale, my objective was to determine the life history of this species in Tennessee.

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MATERIALS AND METHODS

Chionaspis salicisnigrae on *S. nigra*, was studied under both field and laboratory conditions from 1984-89 at The University of Tennessee, Knoxville. Greenhouse populations were maintained on black willow cuttings (6 to 26 cm long) grown in an equal mixture of clay, sand and peat in plastic pots (10 cm in diam.). Field populations of *C. salicisnigrae* on 6 infested black willow trees and 12 potted saplings, located at the U.T. Plant Science Farm, were sampled weekly. Collections of scale insects from infested branches (2 to 4 cm long) were taken to the lab to be processed, stained, and mounted on slides to construct the life history of the species. In the greenhouse, fecundity was determined by counting the number of eggs deposited under the test of 100 females, and by placing the females in Hoyer's solution to count the remaining number of eggs visible through the derm. Number of generations per year and developmental rates were monitored by transferring a minimum of 100 (100-145) newly emerged crawlers to each of 12 uninfested host plants upon eclosion. The tests were replicated 4 successive years from 7 Jan. 1984 to 31 Dec. 1989.

RESULTS AND DISCUSSION

The black willow scale is a multivoltine species that overwintered as eggs under the parental tests. Females undergo three developmental stages, the mobile crawler stage followed by the sessile second and adult stages. Males have additional prepupal and pupal stages before development into the mobile adult stage. Waxy tests of the immature stages were enlarged by moving their abdomens side to side while secreting wax through the pygidial macroducts as described by Stoetzel (1976).

Populations in the greenhouse developed one to two weeks earlier than those in the field. Due to the mild winter and spring in 1989, overwintering eggs began to hatch about two weeks earlier than for previous years. Females deposited a mean of 152 (18-265) eggs over a 10-14 day period. Absolute fecundity was not obtained. At eclosion, the chorion split anteromedially and the crawler freed itself with leg movements. Eclosion of eggs within the population was staggered and may account for the overlapping of stages within a generation. The smooth chorion of each egg was covered with minute, waxy filaments that prevent the eggs in a cluster from adhering to one another. Eggs were 0.25 mm long, 0.10 mm wide, and reddish-purple. Overwintering eggs were present from mid-November to 1st week in May (Fig. 1). Eggs were deposited in June, August and in mid-November.

The mobile crawlers began emerging the 3rd week in April, 2nd week in June, and the 4th week in August. Color of the newly emerged crawler was similar to that of the egg. Several of the female crawlers settled under the old parental tests which eventually resulted in a heavy encrustation on the branches. Heaviest infestations on willow trees occurred on the trunk and branches in the lower 1/3 to 1/4 region of the tree or sapling. As competition for space increased on older branches, the distance crawlers settled from each other diminished resulting in complete encrustation of these branches. Those females that settled on new growth were often found near the twig nodes. Most males migrated to the leaves where they settled on the top surface near the veins. Those male crawlers remaining on the twigs and branches frequently settled adjacent to a cluster of females. Once settled on a suitable site, the crawlers began exuding fine, waxy filaments from the dermal microducts and macroducts that gave the specimens a fuzzy appearance. Second instars were found the 1st week in May, 2nd week in July, and 1st week in September. The snow-white tests of the second stage females were subcircular and slightly convex, while those of the males were distinguished by being more elongated with parallel sides and rounded posteriorly. Prepupal males were present from 2nd-to-4th week in May, the 2nd week in July to 1st week in August, and the 2nd-to-4th week in September. Prepupal males developed into pupal males after ca. one week. The immature male tests possessed a flexible posterior exit flap that allowed the adult male to emerge by backing out of the test.

The ephemeral adult males began emerging the 4th week in May, 1st week in August and the 2nd week in September. Upon emergence, males immediately began to seek out and fertilize adult females. Flight activity in males was rare. However, when they came in contact with the edge of a leaf or twig, they would often take to flight. Two adult males have been found among the field population that had no wings. Males were observed to walk over the surface of an infested branch constantly tapping the female tests with their antennae. When a suitable female was encountered, the male would raise the posterior of the abdomen bringing forward the genitalia between the legs and positioned it beneath the female test at the anal groove in search of the vulvar orifice. After mating, males often groomed themselves by rubbing the genitalia between the prothoracic legs before beginning a search for other females. Males observed died within 24-36 hours after emergence.

The adult females were present the 3rd week in May, 4th week in July and 3rd week in September. The lady beetle, *Rhyzobius lophanthae* (Blaisdell) (Coleoptera: Coccinellidae), was commonly found feeding on eggs deposited beneath the test of the female. Upon discovery of a

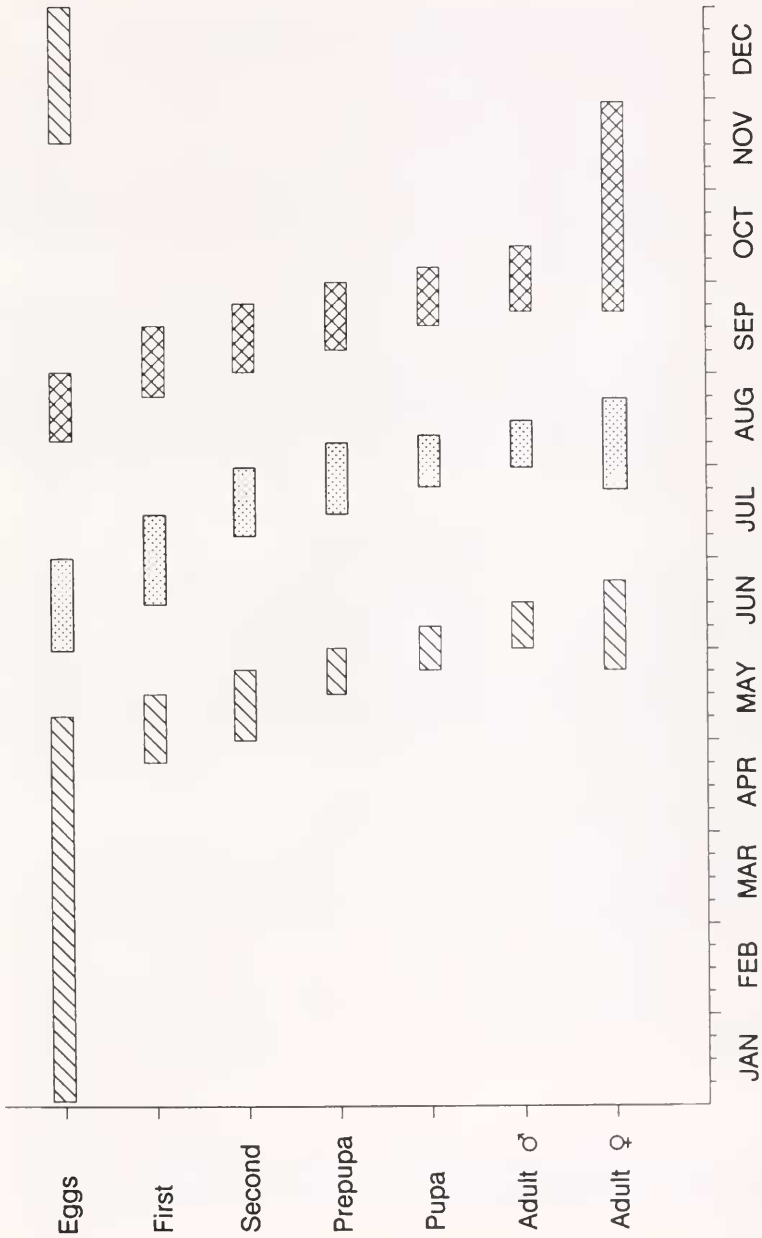


Figure 1. Development of the black willow scale in Tennessee.

gravid female, the lady beetle chewed an irregular hole in the dorso-posterior section of the scale test to feed on the eggs.

The black willow scale was found to have three generations per year in Tennessee which differs somewhat from the two generations reported by Hollinger (1923), Langford (1926) and Kosztarab (1963) for studies on more northern and western populations. The report of 33 (11 - 54) eggs per female by Langford (1926) appears quite low in comparison to some 152 (18-265) eggs per female found in this study. Additional studies are needed to determine the influence of temperature on development and morphology of the various stages of the black willow scale.

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